

Where Products Come From, How They're Made, and the Waste They Produce

In this unit, teachers and students will develop a foundation for understanding the importance of managing waste properly. Students will learn where the products they use every day come from and how much and what kind of waste these products create. They also will learn that waste is not only created by throwing things away, but it also can be produced by human activities such as mining raw materials from the ground and manufacturing goods in factories. This part of the resource will help students understand why it is important to prevent waste in the first place, recycle, compost, and reuse—activities they will learn more about in the next unit.

Natural Resources

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Grade Range	K	✓				
	1	✓	✓			
	2		✓	✓		
	3		✓	✓		
	4					
	5				✓	✓
	6				✓	✓
Subjects Covered	Math					
	Science	✓	✓	✓	✓	✓
	Language Arts			✓		
	Social Studies				✓	✓
	Art	✓	✓			
	Health					
Skills Used*	Communication	✓	✓		✓	✓
	Reading			✓		
	Research				✓	
	Computation					
	Observation/Classification	✓			✓	
	Problem Solving			✓	✓	
	Motor Skills	✓	✓			✓

*See Glossary of Skills for more details.

Natural Resources

What Are Natural Resources?

Natural resources are useful materials from the Earth, such as coal, oil, natural gas, and trees. People use natural resources as **raw materials** to manufacture or create a range of modern conveniences. Water and food provide humans with sustenance and energy, for example, and fossil fuels generate heat as well as energy for transportation and industrial production. Many of the same natural resources used by people are important to plants and wildlife for survival as well.



Virgin Versus Recovered Resources

Resources used for the first time are considered **virgin resources**, and their extraction, processing, and use requires a great deal of energy and can create pollution. **Resource**

recovery is a practice that conserves natural resources by extracting used materials (e.g., paper, glass, and metals) and energy from the waste stream and reprocessing them for reuse. For example, a company can create plastic from oil, a virgin natural resource, or it can use recovered plastic from recycling programs. If a company uses recovered plastic, it is actually saving materials that would otherwise become waste, helping to prevent the depletion of natural resources, conserving energy, and preventing pollution that would have been created in the extraction and processing of oil from the ground.

In addition to the benefits already discussed, using recovered resources reduces threats to **biodiversity**. Natural resource extraction, along with other human activities, increases the rate at which species of plants and animals are now

vanishing. Diminishing the Earth's biodiversity has a substantial human cost because wild species and natural ecosystems are important resources. For example, some economists estimate that the lost pharmaceutical value from plant species extinctions in the United States alone is almost \$12 billion. Reducing the land

Biodiversity

Biodiversity refers to the variety of organisms that live on Earth. Supporting so many different organisms requires the conservation of the natural resources they need to survive. Using natural resources can not only deplete the Earth of the resources themselves, but by destroying critical **habitats**, it can also drive some species to extinction, ultimately reducing biodiversity.



disturbance and pollution associated with virgin materials extraction by using recovered materials, therefore, helps stop the degradation of the Earth's ecosystems.

Renewable Versus Nonrenewable Resources

Some natural resources are nonrenewable and some are renewable. **Nonrenewable resources** are those that become depleted more quickly than they naturally regenerate. One example of a nonrenewable resource is mineral ore. Once mined and used completely, it is gone forever for all practical purposes, because it will take millions of years to regenerate.

Renewable resources can be replenished at approximately the same rate at which they are used (for example, sun and wind, which can be used to provide energy).

Products Made From Natural Resources

People use an abundance of resources to survive in a continually developing world. Globally, however, some people live simpler lifestyles than others and therefore use fewer resources. The following table lists some natural resources and the products and services people produce from them.

Natural Resource	Product/Service
Trees	Paper, furniture, fuel
Cotton plant	Clothing
Oil/Petroleum	Plastic, fuel
Gas	Fuel
Coal	Fuel
Iron ore	Steel products (cans, bridges)
Bauxite ore	Aluminum products (cans, car parts)
Gold	Jewelry, dental material
Copper	Wire, coins, electrical equipment
Manganese	Steel, cast iron
Cobalt	Steel, jet engine parts, cutting tools
Platinum	Air pollution control and telecommunications equipment, jewelry
Chromium	Stainless steel, green glass, gems (rubies and emeralds), leather treatment
Diamonds	Jewelry, mechanical equipment

Renewable or Nonrenewable—or Both?

Some resources can be considered both renewable and nonrenewable. Trees are considered a renewable resource because their supply can be replenished (e.g., more trees can be planted). If, however, an entire forest of 400-year-old trees is cleared and a new-growth forest is planted, the supply of old-growth trees has not been replenished. It takes many generations for an old-growth forest to mature, and so, old-growth trees are considered nonrenewable. Trees are a complex resource because as a forest, their environmental and economic contributions often depend on their age. For example, clearing a forest of 200-year-old Redwoods, unlike clearing a forest of new-growth pines, reduces the corollary biodiversity that is usually found in old-growth forests.

What Are the Benefits of Natural Resources?

Renewable resources offer a number of environmental and economic benefits over nonrenewable resources. One obvious benefit is the infinite supply of renewable resources—they cannot be depleted. Another benefit of using renewable resources is self-reliance. A country that can provide its own renewable resource, such as solar-powered electricity, need not rely on other countries for an energy source. Additionally, renewable resources offer communities relief during periods of recovery from natural disasters. When communities lose standard services that require the use of natural resources (e.g., electric power or natural gas), renewable resources, such as wind and solar energy systems, are used to provide these services until the usual methods of achieving service can be restored. Following Hurricane Andrew in 1992, for example, a south-Miami subdivision continued to have working streetlights because they were all **photovoltaic** (PV)-powered. The areas became neighborhood gathering spots for a community left without electricity following the storm. In several cases, homes equipped with PV systems were able to keep minimal services running and became emergency shelters for surrounding residents who had lost power.

Greenhouse Gas: A gas that absorbs and retains heat from the sun. Greenhouse gases include methane, ammonia, sulfur dioxide, and certain chlorinated hydrocarbons. A buildup of these gases traps warmth in the Earth's atmosphere, changing the global climate.

Global Climate Change: Natural- or human-induced change in the average global temperature of the atmosphere near the Earth's surface.

What Are the Challenges of Using Natural Resources?

Extracting, processing, and using natural resources creates air, water, and land pollution, which can cause global environmental problems. For example, carbon dioxide, which is produced from **deforestation**, and from burning coal, oil, and natural gas (fossil fuels), is a critical **greenhouse gas**. Many scientists believe that the buildup of greenhouse gases in the atmosphere can cause global climate change. Over time, this condition could pose serious dangers around the world, prompting such disasters as flooding, drought, and disease.

In addition, extracting and using resources can disturb relationships within **ecosystems**. For example, the effects of clearing an old-growth forest for wood can destroy habitats used by



What Are Ecosystems?

Ecosystems are self-regulating communities of plants and animals that interact with one another and with their nonliving environment. Examples of ecosystems include ponds, woodlots, and fields.

Organisms within an ecosystem are connected by energy. Individuals in a community feed on each other, thus transferring energy along a **food chain** or **food web**. In a food chain, energy is transferred from one organism to another in a linear form. For example, the sun provides fuel for a fig tree, which provides sustenance for wasps. The wasps are a food source for spiders, which are eaten by birds. More complex food webs can be thought of as a network, involving energy transfers among several organisms.

many animals, forcing them to find homes elsewhere. If these animals leave an ecosystem, further disturbances can occur within plant and animal populations that depend on these species.

Additionally, with the absence of tall trees in the forest, lower vegetation would lose shade provided by the upper canopy, resulting in increased exposure to sunlight and decreased moisture. Changes in an ecosystem's climatic conditions will eventually change vegetation type, which will alter the kinds of animals that can exist in that community. Over time, if enough ecosystems are affected, an entire community type can change (e.g., over-harvested fields can turn into deserts).



Population growth, increasing affluence, technological change, and urbanization are all responsible for rapidly rising resource consumption all over the world. The relationship between population growth and increased resource use varies among developed and

undeveloped nations. For example, according to the Department of Energy, residents of the industrialized world comprise only 20 percent of the world's population, yet consume 86 percent of its iron and steel, and 76 percent of its timber. Despite the inconsistent relationship between resource use and developed and undeveloped nations, it is apparent that worldwide, more people use more resources. With population, technology, and lifestyle demands growing exponentially, people are using increasing amounts of many natural resources.

Natural Resource Consumption Facts

- The United States uses one million gallons of oil every 2 minutes.
- Every American uses about 47,000 pounds of newly mined materials each year.
- A television requires 35 different minerals, and more than 30 minerals are needed to make a computer.
- Over the past 40 years, global consumption of wood as industrial fuel rose by nearly 80 percent. North America alone accounts for about 40 percent of both production and consumption of wood as industrial wood products.
- In 2001, each person in the United States threw away an average of 4.4 pounds of waste each day.

(Sources: Natural Resources Defense Council, 1996; National Mining Association, 2000; World Resources Institute, 2000; EPA, 2003.)

Innovative Technology Using Recovered Materials

Plastic lumber was developed to utilize low-cost materials such as plastic grocery bags and wood chips or sawdust. Used as a wood alternative, plastic lumber offers several advantages over using lumber; it is long lasting, requires limited upkeep, and resists warping and decay. One example of how using plastic lumber can conserve and recover resources is a bridge at Ft. Leonard Wood, Missouri. The construction of the plastic lumber bridge utilized 13,000 pounds of mixed plastics that otherwise would have gone to waste. This exercise in reuse translates into significant natural resource conservation.

Emerging Trends

Increasing demands for natural resources have spurred new methods for conserving existing resources. More and more companies are developing new and innovative technologies that use recycled materials as raw materials in the manufacture of products. Some steel producers, for example, use minimills and a manufacturing process that uses virtually 100 percent recovered scrap steel as the raw material.

Recovery—In Action

- More than 65 percent of the steel produced in the United States is made from recovered steel.
- The average aluminum can contains an average of 50 percent post-consumer recycled content.
- By 2003, the paper industry relied on recovered paper for 50 percent of its feedstock.
- Using recovered aluminum cans saves 95 percent of the energy required to make the same amount of aluminum from bauxite, its virgin source.
- Recycling and reuse of 2,000 pounds of paper saves 7,000 gallons of water and 380 gallons of oil.

(Sources: Steel Recycling Institute, 2000; Aluminum Association, 2000; American Forest and Paper Association, 2000; The Can Manufacturers Institute, 1997; Weyerhaeuser Company, 1999.)

How Can You Help?

An increasing number of individuals are also practicing **conservation** methods by using less—such as buying products with less packaging. (See the Teacher Fact Sheets titled *Recycling* on page 101 and *Buying Recycled* on page 107). Certain lifestyle changes, such as composting food scraps rather than buying fertilizer (see the Teacher Fact Sheets titled *Source Reduction* on page 79 and *Composting* on page 141), also preserve natural resources. Other suggestions

for ways to practice conservation of natural resources include:

- Reducing waste by reusing paper grocery and lunch bags or eliminate waste by using cloth bags.
- Donating old toys, clothes, furniture, cars, and other items to organizations such as the Salvation Army rather than throwing them in the garbage.
- Closing the recycling loop by purchasing recycled-content products and packaging.

Additional Information Resources:

Visit the following Web sites for more information on natural resources and solid waste:

- U.S. Environmental Protection Agency (EPA): <www.epa.gov>
- U.S. EPA Office of Solid Waste composting site: <www.epa.gov/epaoswer/non-hw/composting/index.htm>
- World Resources Institute: <www.wri.org>
- Natural Resources Defense Council: <www.nrdc.org>
- United States Department of Energy's National Renewable Energy Laboratory: <www.nrel.gov>
- United States Department of Energy's Center of Excellence for Sustainable Development: <www.sustainable.doe.gov>

To order the following item on municipal solid waste, call EPA toll-free at (800) 490-9198 or look on the EPA Web site <www.epa.gov/epaoswer/osw/publicat.htm>.

- *A Collection of Solid Waste Resources* on CD-ROM

Nature Romp



Objective

To gain an appreciation of nature and the environment.



Activity Description

Students will take a nature walk, make observations, and collect natural objects for an art activity.



Materials Needed

- Bags (e.g., old lunch or grocery bags)
- Paint
- Smocks
- Crayons
- Glue
- Scissors
- Pens or pencils
- Construction paper
- Large sheet of paper



Key Vocabulary Words

Nature
Environment
Habitat



Duration

2 hours



Skills Used

Communication
Observation/classification
Motor skills



Activity

Step 1: Draw a chart on a large piece of cardboard or poster board with headings that describe several types of natural objects that students could find outdoors. Headings might include rocks, leaves, flowers, bugs, animals, nuts (see below). Attach a sample of each of these objects (e.g., for flower, it can be a flower petal or seed). Discuss each of the

objects and tell students their mission will be to find evidence of these items in the outdoors. Examples of the types of evidence students might bring back that would fit into the category headings could include pebbles, leaves or needles, seeds, acorns, feathers, and twigs.

Step 2: Bring students outdoors into the school yard, a field, a patch of woods, a garden, or other natural area, no matter how

Rocks	Leaves	Flowers	Bugs	Animals	Nuts



Science



Art

small. Distribute a bag to students, and tell them they are on a scavenger hunt to find evidence of the items discussed in class. Please ensure that students only collect items that have fallen to the ground or are dead; no live plants, flowers, insects, or other organisms should be collected, nor should bark be peeled off trees. Teachers might have to work closely with students to help them locate and identify appropriate items.

Step 3: While students are collecting objects, ask them for their observations. You might want to talk about their discoveries, focusing on colors, senses, seasons, or animal lives (e.g., hibernation, food).

Step 4: Regroup in the classroom and help students spread everything they've collected on a table. Ask the students to categorize their items into the headings on the chart you prepared earlier. Compare the different colors, sizes, and shapes of each of the items. Group everyone's objects together and attach them to the posterboard, or let students keep their own pile and proceed to Step 5.

Step 5: Prepare for painting and gluing by putting on smocks and gathering the art supplies (e.g., paper or cardboard, glue, crayons, paint, construction paper, and scissors). Ask students to create artwork, using objects they collected, that depicts the natural environment they just explored. Students can glue natural objects directly onto the paper, or they can create a sculpture. Students could also create cut-outs of animals or plants that they observed.

Step 6: Allow the artwork to dry and hang posters around the classroom to bring a little of the environment indoors!

Teachers: Please note that many federal and state land management agencies prohibit or discourage collecting living or non-living items in a natural environment. Depending on your situation, you might want to consider directing students to draw or paint the live organisms they find as a substitute for the real thing.



Assessment

1. Ask students if they found anything outside that they had never seen before. If so, can they explain what it is?
2. Review some of the specific items found and what their purpose is.
3. Ask students to share what they like best in nature.



Enrichment

1. Schedule a day trip to a local nature center where students can participate in further outdoor education.
2. Adopt a specific tree in your schoolyard and observe how it changes through the seasons. Have students draw the tree during different seasons.
3. Participate in an environmental education workshop and obtain copies of the conservation/environmental education activity guides entitled *Project WILD K-12*, *Project WILD Aquatic Education*, or *Project Learning Tree*. Project WILD's state coordinators and their facilitators conduct workshops (usually 6 hours long) for educators within their state. The activity guides are provided to those who participate in the workshops. They include numerous indoor and outdoor hands-on activities related to the environment, with a focus on wildlife. Other classroom materials are available without participating in the workshops. For more information, and to find out how to get information in your state, visit the Web site <www.projectwild.org>. You can also contact the Project WILD National Office at (713) 520-1936 or <info@projectwild.org>.

An Ecosystem Escapade



Objective

To learn how animals and plants depend on each other in ecosystems.



Activity Description

Students will role-play elements of a food web to illustrate the connections in ecosystems.



Materials Needed

- Paper or cardboard
- Crayons or markers
- Scissors and string
- Hole-punch



Subjects Covered

Food chain
Food web
Ecosystem



Duration

1 hour



Skills Used

Communications
Motor skills



science



art



Activity

Step 1: If possible, take the students outside into a natural environment, such as woods (otherwise, ask them to use their imaginations and conduct the lesson indoors). Explain what an ecosystem is and what types of ecosystems are in your area. Ask them to identify different animals and plants that they see when they go outside. Discuss in a group what all animals and plants have in common (i.e., that they need to eat). Explain how some animals eat plants, some plants eat animals (e.g., a Venus Fly Trap), and some animals eat other animals. Ask the students what they eat.

Step 2: Explain that animals and plants rely on each other for food and for survival. All of the plants and animals working together, eating each other and being eaten, is part of nature and can be

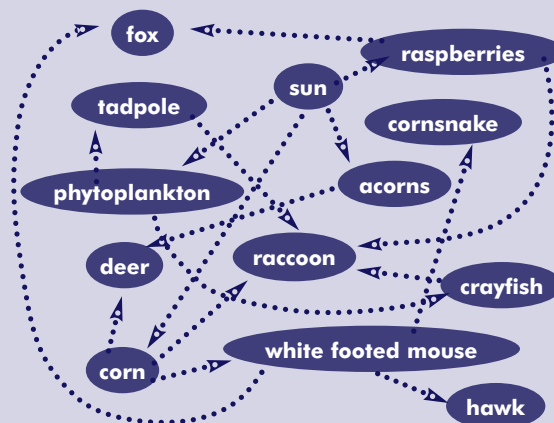
Sample Food Chain:

(in an Eastern U.S. deciduous wooded ecosystem)



Sample Food Web:

(in an Eastern deciduous wooded ecosystem)

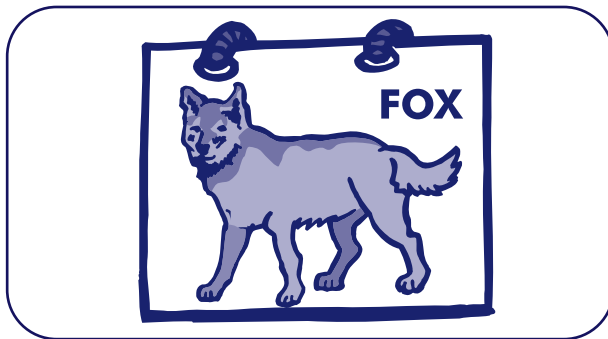


Arrows indicate the direction that energy is transferred.

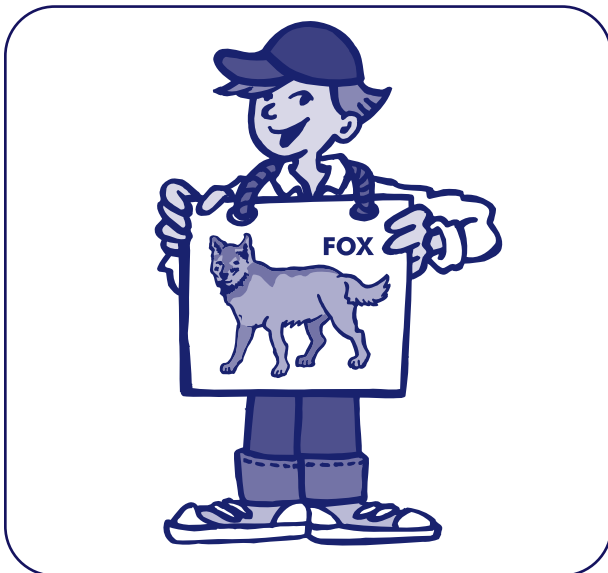
described as “food chains” or “food webs.” Show the students an example on the board (see sidebar for examples of food chains and food webs).

Step 3: Based on the animals and plants that are named by the students, create a food web on the board and have students help you decide which animals and plants eat each other.

Step 4: Have each student pick one animal or plant in the ecosystem described on the board. Instruct each student to draw a picture on a piece of paper or cardboard of their animal or plant and write its name near the picture.



Step 5: Using a hole-punch and string, help students create a placard to identify them as a particular animal or plant.



Step 6: Facilitate an exercise with the students in which they find the animal or plant that they eat and link hands with that person. If the food web is created properly, many people should be holding hands.



Assessment

1. As Step 6 is being conducted, ask students to remember what eats what. If there is more than one option, acknowledge students when they say a correct answer, even if no one in the class is role-playing that particular plant or animal.
2. Ask students why animals eat other animals or plants.
3. Ask students what would happen to the plants and animals in the food web if one plant or animal disappeared. Explore with students reasons why an animal or plant would disappear.



Enrichment

1. Create illustrations and placards exemplifying a chain of foods that the students eat. Then link hands to create one or more chains (for example, people eat hamburger, which is made from cows, which eat grass).
2. Teach the students the words to “This Land Is Your Land” and sing it as a class. Discuss some of the lyrics that describe particular ecosystems (e.g., redwood forests).
3. Tell students the different types of ecosystems that exist in your geographic location, such as streams, ponds, forests, deserts, and meadows. Have each student pick one and draw a picture of it, including animals and plants that live in it. If possible, have students collect items in nature, such as leaves, acorns, bones, bark, to include in their artwork.

Dr. Seuss and Resource Use



Objective

To learn about resources and the potential negative impacts humans can have on the environment through overconsumption.



Activity Description

Students will listen to the teacher read *The Lorax* by Dr. Seuss. The teacher will then show the class products that exemplify reduced resource consumption.



Materials Needed

- *The Lorax* by Dr. Seuss



Key Vocabulary Words

Natural resources
Pollution
Ecosystem
Consumption



Duration

2 hours



Skills Used

Reading
Problem solving



Activity

Day 1: Listening Exercise

Step 1: Introduce and discuss the concept of natural resources and product consumption with students (refer to the Teacher Fact Sheet titled *Natural Resources* on page 5). Review vocabulary words above. Note how humans continue to consume more and more products, which takes a toll on the environment.

Explain that ecosystems are comprised of many different interrelated components, such as different plant and animal species. Add that when one part of an ecosystem is disturbed, it impacts the entire ecosystem.

Step 2: Take students to a quiet area outside where they can sit comfortably and listen without distractions. Have students sit in a circle. Once settled, ask students to close their

eyes and take three long deep breaths to help them relax.

Step 3: Once students are calm and attentive, read *The Lorax* out loud. In this story, a character called the "Once-ler" cuts down "Truffula" trees for their valuable silk tufts and uses them to make "thneeds." Due to increasing thneeds sales, the Once-ler builds a factory and invents an axe that can cut down four trees at once. The Lorax, a wise creature of the forest, recognizes the potential harm this could have on the Truffula tree forest ecosystem. He speaks up to defend the trees, animals, air, and water that the Once-ler is destroying in pursuit of more money and to satisfy those who want thneeds. Eventually all the Truffula trees are depleted, and the Once-ler can no longer produce thneeds. The once beautiful site is left contaminated with polluted air and water.



science



language
arts



Journal Activity

Remind students that the Lorax spoke for the trees, "for the trees have no tongues." Ask students to choose one thing in the environment that is in jeopardy and cannot speak for itself and defend it. Why is it in jeopardy?

Step 4: Discuss the story with the students. Begin by asking them why the Once-ler is called the "Once-ler." Evaluate why the Once-ler had to use all the Truffula trees and ask the students to speculate why he would not listen to the Lorax. Ask the students if they can suggest a way for the Once-ler to make thneeds without destroying the ecosystem in which the Lorax lived.

Step 5: Have students suggest "thneeds" that they often use (e.g., clothes, food, books). Instruct students to go home that night and think about how they can consume less resources while still using their thneeds. One example is buying used clothing instead of new clothing. Instruct students to bring in their thneed for a "show and tell" activity the following day.

Day 2: "Show and Tell"

Step 1: Have students present their thneed and explain their solution for consuming less resources while using their thneed. If the student cannot think of a solution, ask the class to contribute its ideas.



Assessment

1. Ask the students why the Once-ler cut down the Truffula trees.
2. Ask the students why the Brown Bar-ba-loots have to leave the forest after the Once-ler starts his thneed production. Could something like this happen in real life? How?
3. Have students list three ways the Thneed factory caused problems for the Truffula Tree forest and its residents.
4. Have students explain what the Lorax's message "Unless" means (answers should include the need for future generations to protect and care for the Earth).



Enrichment

1. Break students into groups of approximately five students. Have students rewrite *The Lorax* so that the Truffula tree forest and its inhabitants are saved. Students can use this to develop a script and act out their own story in front of the class.
2. Instruct students to create a collage of their needs and wants, labeling them "thneeds" and "thwants," by cutting pictures out of magazines. Once the collages are complete, ask the students to tell the class about opportunities to use less resources with the thneeds and thwants.

Sources of Resources



Objective

To identify natural resources as renewable or nonrenewable; to learn where resources come from; and to understand how overconsumption of limited supplies can be problematic.



Activity Description

Students will research resources, investigating their sources and uses. They will present conclusions to the class and identify on a map where the resource is most often found.



Materials Needed

- Wool sweater
- Plastic milk jug
- Metal can
- Glass bottle
- Plastic boot or raincoat
- Fruit and/or vegetables
- Wood object (chair, ruler, etc.)
- Cotton T-shirt
- Paper
- Dairy product (egg, cheese, milk, etc.)
- Leather (belt, shoe, purse, etc.)
- Pushpins
- Paper (used to make small labels/tags)
- Scissors
- Pens
- World map



Subjects Covered

Natural resources
Renewable
Nonrenewable
Raw materials
Consumption



Duration

1 hour



Skills Used

Communication
Research
Observation/classification
Problem solving



Activity

Step 1: Display all of the materials from the "Materials Needed" list above except for the last five items. Discuss the concept of natural resources with the students and ask them to identify what each of the objects on display are made from (refer to Teacher Fact Sheet titled *Natural Resources* on page 5). List their answers on the board. Use the list to define and explain the key vocabulary words.

Valuable Natural Resources

Aluminum	Nickel
Chromium	Oil
Coal	Petroleum
Cobalt	Platinum
Corn	Silver
Diamonds	Tin
Fish	Wheat
Fresh Water	Wool
Gold	Zinc



science



social
studies



Journal Activity

Ask students to list the kinds of natural resources they use frequently. Are they renewable or nonrenewable? Ask students to write about what they would do if the world supply of the resource ran out.

Step 2: Have a brainstorming session with students to identify well-known resources such as those listed in the “Valuable Natural Resources” sidebar. Try to come up with at least as many resources as there are students in the class. Write the list on the chalkboard.

Step 3: Have each student choose a natural resource from the list.

Step 4: Instruct students to research their chosen resource. They should use library and Internet resources to investigate the dominant sources and uses for their resource. Students should also research consumption of their resource and analyze whether their resource might become depleted in the near future.

Step 5: Display a large map of the world in the front of the classroom.

Step 6: Have students write the name of their resource on several small pieces of paper.

Step 7: Have students present information about their resource to the class, discussing their research conclusions. Students should begin their presentation by telling the class what their resource is and where it is most typically found. Students should pin the paper that labels their resource on the map at the appropriate regions. Additionally, students should discuss whether the resource is renewable or nonrenewable and tell the class some of the resource uses and any associated consumption issues.



Assessment

1. Ask students to identify the natural resources used to make items, other than those previously studied. Have students think about their house, family car, room, school, or other familiar objects in their lives.
2. Test students’ memory of where some of the assigned resources come from. Take the pins out of the map and have students place the pins at the proper geographic locations as you call out the resources.
3. Ask students to explain and discuss the importance of monitoring resource consumption. Also, discuss why it is important to develop and discover alternatives to certain resources.



Enrichment

1. Have students research, via the Internet or the school library, information on our global population and specific resource quantities. Have them calculate and record figures to determine the approximate future supply of particular resources.
2. Have students pick their favorite resource and identify ways to conserve it. With this information, have students write and act out a skit that exemplifies resource conservation practices.
3. Conduct a geology lesson that incorporates a discussion of the formation of some common natural resources (e.g., coal, petroleum, diamonds). Ask students why all resources are not located right in their backyards. Discuss what this means in terms of resource availability (e.g., how we get resources from other countries).

How Many People Does it Take to Ruin an Ecosystem?



Objective

To learn how animals and plants depend on each other in ecosystems and how human activities can impact ecosystems.



Activity Description

Students will role-play elements of a food web to illustrate the connections in ecosystems and will respond to real-life scenarios that impact ecosystems.



Materials Needed

- Red stickers
- Green stickers
- Black stickers
- Cardboard
- String



Subjects Covered

Food chain
Food web
Ecosystem



Duration

1 to 2 hours



Skills Used

Communications
Motor skills



Activity

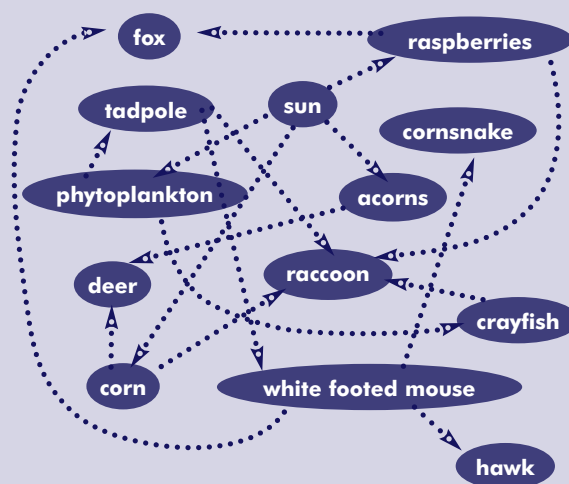
Step 1: Discuss ecosystems with students and identify the types of ecosystems that exist in your geographical area. Select an ecosystem to study (e.g., forest, meadow, stream, pond).

Step 2: As an in-class exercise with students, brainstorm some of the animals and plants that make up that ecosystem. Have a student write everything on the board and have the class create links between the items that plants and animals eat and those that eat them. The result should be a complex food web (see example in the side bar). Leave the food web on the board until the next day.

Step 3: Assign each student to a particular plant or animal that exists in a

Sample Food Web:

(in an Eastern U.S. deciduous wooded ecosystem)



Arrows indicate the direction that energy is transferred.



science



social studies

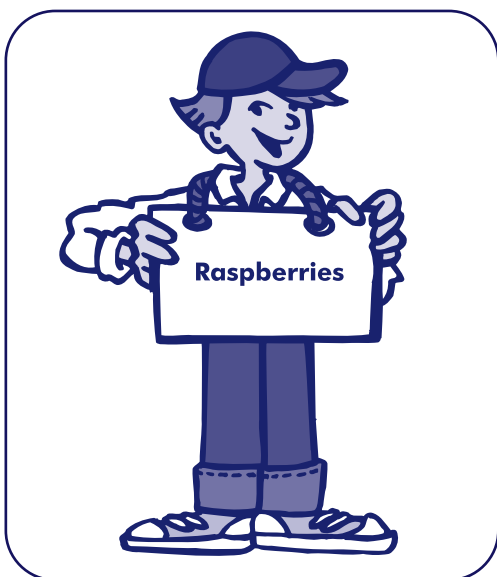


Journal Activity

Ask students to describe a natural place that is special to them. Have them write about what lives there and why it is so magical. Or ask them to write a poem that is in the shape of something in nature.

specified ecosystem. Have them research (either at the school library or on the Internet) what the plant eats, what eats it, and any factors that are necessary in its habitat for survival. Have students tell the class what they found, in 5 minutes or less, modifying the existing food web as you go.

Step 4: Have students create a placard to identify themselves as a certain plant or animal. All students should start off with a green sticker on their placard, indicating that the population of their plant or animal species is healthy.



Step 5: Facilitate an exercise in which each person holds hands with the person wearing a

sign of the animal or plant that they eat. The result should be a tangled web of students, holding several people's hands.

Step 6: Now, introduce some human-created scenarios that would affect this ecosystem (see examples below). When an animal or plant is affected, a red or black sticker must be placed on the person's placard. For example, in a meadow ecosystem, a scenario might be that a farmer applies pesticides to the meadow, which kills off the Monarch Butterflies. Whomever is playing the role of the Monarch Butterfly would put a black sticker over top of the green sticker (and should be removed from the web). Students should be asked to identify what other species are affected by the disappearance of the Monarchs in this ecosystem. Those that are affected (that depend on the Monarch for food or that serve as prey for the Monarch) should place a red sticker over top of the green sticker, indicating the species is in trouble.

Sample Scenarios of Human Activities That Could Affect Ecosystems:

- Pesticide-containing runoff makes its way into a stream from which animals drink.
- A household dumps used oil in the storm drain, which empties out into a bay.
- An old-growth forest is clear-cut.
- Hazardous waste from a factory is dumped into the river.
- Acid rain from factories kills off trees in a forest 200 miles away.

Step 7: Introduce several detrimental scenarios until the students decide that the ecosystem is no longer viable and should be considered destroyed.



Assessment

1. Have students define and describe a food web.
2. Ask students to describe the characteristics of an ecosystem.
3. Ask students to explain how several elements of an ecosystem can be harmed even if only one element is initially affected.



Enrichment

1. Repeat the exercise described in Step 6, but this time use examples of recent human actions and efforts to make a positive impact on an ecosystem. For example, through the work of biologists and naturalists, the fox is reintroduced into an ecosystem and environmental groups help Congress to pass and enforce laws to protect its habitat.
2. Present the class with a scenario that pits human activities against an ecosystem. Break the class into groups and assign different

roles to the different groups. For example, one group could represent a developer that wants to fill in a wetland to build a shopping mall. Another group could represent a group of citizens of that community that want to save the wetland. Another group could represent the new workers who could benefit from jobs at the new mall. Students should be instructed to think of all the reasons why they would support or oppose the mall from their perspective and have a mini-debate about the issue.


3. Take the students on a field trip to a local park, stream, pond, or wooded area, and take an inventory of all the common birds and plants that are observed in that ecosystem. Students could learn how to use field guides and identify the species observed.
4. Give the students a list of species that have become extinct in the last 100 years and ask them to research how they became extinct (e.g., overharvesting, habitat destruction) and present the information to the class, along with a description of the species and/or a photograph. This will help the class appreciate the beauty of many of the extinct species and gain an understanding of the human activities that caused their demise.



CHAPTER

1.2

Products



Teacher Fact Sheet: Products . . . 25

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Grade • Subject • Skills Index

Activity Name		A Matching Match	Tracing Trash Back to Its Roots	Putting Products Under the Microscope	Let's Go Eco-Shopping	A Product's Life
Grade Range	K	✓				
	1	✓				
	2					
	3		✓			
	4		✓		✓	
	5			✓	✓	
	6			✓	✓	
	7				✓	✓
	8				✓	✓
Subjects Covered	Math					
	Science		✓	✓		✓
	Language Arts	✓		✓	✓	✓
	Social Studies	✓	✓	✓	✓	
	Art				✓	✓
	Health					
Skills Used*	Communication		✓	✓	✓	✓
	Reading					✓
	Research				✓	✓
	Computation					
	Observation/Classification	✓		✓	✓	
	Problem Solving		✓	✓	✓	
	Motor Skills	✓				✓

*See Glossary of Skills for more details.

Products

How Are Products Made?

Everyone uses a variety of **products** each day—from toothbrushes to notebooks to lunch boxes to video games. Each of these products has an effect on the environment in one way or another. Sometimes merely using (or misusing) a product can affect the health of people and the environment. Some products can affect the environment through the way they are made or disposed of. For example, products made from virgin **natural resources** have different effects on the environment than those made from **recovered resources**. By understanding a product's **life cycle**—the development, use, and disposal of a product—people can make better decisions about what products to buy and how to use them wisely.

A product's life cycle generally includes design; exploration, extraction, and processing of resources (raw materials); manufacturing; distribution and use; and retirement. If a product is made from 100 percent recovered materials, exploration and extraction of virgin materials is not necessary. If a product is recycled, composted, or reused, people do not have to throw it away. By altering the product life cycle in these ways, people can save energy and resources, and therefore, prevent waste and pollution.

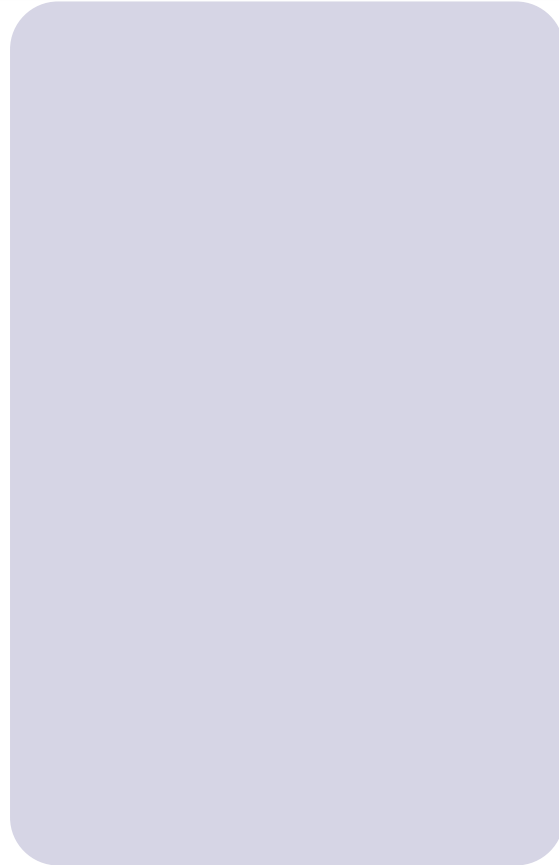
The Product Life Cycle

The following sections describe each stage in the product life cycle, as well as the challenges, benefits, and emerging trends associated with each step.

Design

Product design can involve research, testing, and development. This includes development of synthetic materials, such as plastics, which derive from natural sources.

Some products are designed to be used only once (**disposable**), while others are designed to be used many times (**durable**). Engineering and material choices can determine whether a



product is durable, disposable, or **recyclable**, or a combination.

Over the last few decades, as people's lives have become more complicated and technology more advanced, many consumers have come to desire the convenience of disposable items over the durability of reusable ones. Also, it is sometimes easier to replace items rather than fix them. Thus, more and more items end up as trash in **landfills** or **incinerators**.

Products are often conceived and designed with a focus simply on how they will be used and with less concern about the other stages in their life cycle. In the past decade, however, consumers have begun to demand more **environmentally preferable products** or "green" products—products that have fewer negative

effects on human health and the environment when compared to traditional products. Manufacturers have responded by offering products that are made from recycled-content materials, low in toxicity, and high in energy-efficiency. Other products have been designed to conserve water, minimize air pollution or, through a combination of factors, have fewer negative impacts on the environment.

Exploration, Extraction, and Processing

Manufacturers must obtain the materials needed to make their products. If a manufacturer uses **recovered materials**, the company can obtain them from recycling processors or other similar sources. **Virgin resources**, however, must be mined (for metals and minerals) or harvested (for wood and other biobased materials) from the Earth. Once they are extracted, they must be processed for use in manufacturing.

The extraction of raw materials generates waste and pollution and requires a great deal of energy. In many cases, the natural resources used in manufacturing are **nonrenewable**. This means that, eventually, the natural resource will be depleted. As more



Product Facts

- Most glass bottles and jars contain at least 25 to 30 percent recycled glass.
- Making 2,000 pounds of paper from trees requires 3,700 pounds of wood, 200 pounds of lime, 360 pounds of salt cake, 76 pounds of soda ash, 24,000 gallons of water, and 28 million BTUs of energy.
- Making an aluminum can from recycled material requires 95 percent less energy than making one from the natural resource raw material, bauxite ore.
- For every 100 pounds of products made, over 3,000 pounds of waste is generated.

(Sources: Glass Packing Institute; Can Manufacturers Institute; Weyerhaeuser Company.)

and more communities offer recycling programs and people participate in them, manufacturers may be able to use increased recovered materials instead of virgin materials to make products.

Manufacturing

Whether a product is made from virgin or recovered materials, often the factories that manufacture the product are specially designed to use a consistent form of material. If a product is made in a plant designed to process virgin materials, changing to recycled materials might not be easy. Changing the kinds of materials used in manufacturing, such as using recycled paper instead of virgin paper, can require changes in technology and equipment and can slow down the pace of production. In the past decade, however, many manufacturing plants have begun retooling and learning to use recovered materials rather than virgin materials, and thus, the variety of recycled-content products has been growing. (See the Teacher Fact Sheet titled *Recycling* on page 101 for more information.)

Manufacturing products generates pollution and usually requires a great deal of energy. Using recovered materials can often save energy and reduce pollution. The manufacturing process also generates waste, but at some manufacturing plants, this waste can be reused.

Distribution and Use

People rely on various products to live in a modern society. Most people purchase and use some type of manufactured product every day because it is easier and more convenient than making the same items from scratch (for example, going to a store and buying a box or bag of rice is much simpler, and more practical, than trying to grow rice in a paddy in the backyard).

After products are manufactured, many must be packaged for transportation and distribution. Often, products are transported long distances across the nation or even internationally before people can purchase and use those items.

Products often require packaging to protect them from spoilage, damage, contamination, and tampering during transportation, storage, and sale. Sometimes packaging is necessary to inform consumers about product benefits, proper use, and other information. While some products might appear to have excessive packaging, in many cases the packaging serves several purposes, without which the products might not be available as widely or as frequently.

Packaging—when it is discarded—can create a great deal of waste. In communities where common packaging materials are not recyclable, these items must be thrown away, wasting precious resources and potential recovered materials.

Product Retirement

After use, many items or packaging are disposed of in landfills or incinerators. Others are recovered for recycling. If products are disposed of in landfills or incinerators, they can no longer provide any benefit. Emissions to air and water from these disposal methods can affect human health and the environment.

Think Globally, Buy Locally

One way consumers can help eliminate the need for excessive packaging is to buy products locally. This concept, known as bioregionalism, works on the idea that if consumers buy products made within their own communities, packaging that would otherwise be needed to protect the products during transportation and storage could be eliminated or reduced.

If products are recycled, composted, or reused, they continue to serve a purpose, either as a raw material or for the same use they were originally intended. Extending a product's life is a way to save natural resources, prevent waste, reduce pollution, and conserve energy.

The more people recycle and buy recycled products, the more incentive manufacturers will have to make products with recovered content.

Additional Information Resources:

Visit the following Web sites for more information on designing and purchasing products with the environment in mind:

- U.S. Environmental Protection Agency (EPA): <www.epa.gov>
- U.S. EPA Office of Solid Waste product stewardship site: <www.epa.gov/epaoswer/non-hw/reduce/epr/index.htm>
- U.S. EPA Office of Pollution Prevention and Toxics, Design for the Environment Program: <www.epa.gov/dfe>
- U.S. EPA Office of Pollution Prevention and Toxics, Environmentally Preferable Purchasing: <www.epa.gov/opptintr/epp>

To order the following additional documents on municipal solid waste and product life cycle, call EPA toll-free at (800) 490-9198 or look on the EPA Web site <www.epa.gov/epaoswer/osw/publicat.htm>.

- *WasteWise Update—Extended Product Responsibility* (EPA530-N-98-007)
- *Puzzled About Recycling's Value? Look Beyond the Bin* (EPA530-K-97-008)
- *A Collection of Solid Waste Resources* on CD-ROM

A Matching Match



Objective

To teach students that many products come from natural resources such as animals and plants.



Activity Description

Students will draw a line from a product to its natural source and then color the pictures.



Materials Needed

- Copies of the *Matching Match* worksheet for each student
- Crayons



Subjects Covered

Natural resources
Products



Duration

1 hour



Skills Used

Observation/classification
Motor skills



Activity

Step 1: Discuss with students that everything we use is made from a natural resource, such as a plant or other resource that comes from the Earth. Some products also come from animals. Provide examples by talking about what students are wearing or items in the classroom and the sources of those items.

Step 2: Either individually or in groups, have the students use the *Matching Match* worksheets to match the different products with their natural resource.

Step 3: Encourage the students to color the pictures.



Assessment

1. Ask the students to name other items that are made from the same natural resources that are listed on the worksheet.
2. Ask students to list other plants and animals that products are made from.



Enrichment

1. Pick a product that is made in your local community, such as paper, ice cream, or wool sweaters, and take the students on a field trip to see how it is made. Ideally, students would see how a raw material is converted into a product.



social
science



art

Matching Match

Name: _____



newspaper



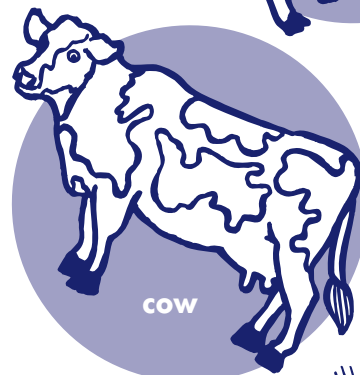
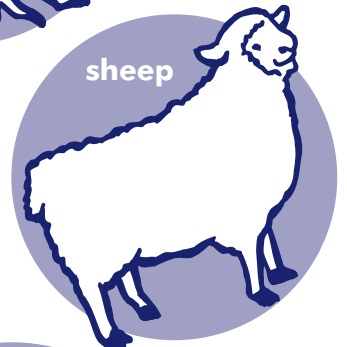
milk



cotton t-shirt



wool hat



Tracing Trash Back to Its Roots



Objective

To teach students to identify the various natural resources used to produce common items that become waste.



Activity Description

Students will play “Trash Bingo” as a method to identify what natural resources are used to make common products.



Materials Needed

- Copies of bingo card for each student (make copies and then cut sheets so half the students get one version of the bingo card and half get a different version).



Key Vocabulary Words

Natural resources
Renewable resources
Nonrenewable resources



Duration

1 hour



Skills Used

Communication
Problem solving



Activity

Step 1: Review and explain the vocabulary words above. Explain that most products are made from natural resources. (Refer to the Teacher Fact Sheets titled *Natural Resources* on page 5 and *Products* on page 25 for background information.)

Step 2: List five categories of natural resources on the blackboard: animals, fossil fuels, metals, plants/trees, and sand. Discuss with students some examples of products that are made from these natural resources. Brainstorm a list of things that are made from natural resources (mostly everything!) and make another list on the blackboard. Make sure there are at least five products for each natural resource category. Encourage students to think of food and beverage items and con-

Common Products

Aluminum can	Grocery bag
Aluminum lawn chair	Hamburger
Apple core	Leather jacket
Bicycle tire	Linen pants
Bologna sandwich	Milk container
Book	Mirror
Bread	Nylon pantyhose
Cereal box	Sandwich bag
Cotton shirt	Soda bottle
Egg shells	Window
Glass bottle of juice	Wool hat



science



social
studies



Journal Activity

Ask students to write about what natural resources mean to them. Ask them to pick a natural resource and describe why it is special or important to them.

Or

Have students write about their favorite toy or game. Have them write a history of where it came from, starting from when it was a natural resource.

tainers, household product containers, and household items (furniture, books, appliances). See suggestions in box if the list is deficient.

Step 3: Explain the rules for bingo, and hand out bingo cards.

Step 4: Select words from the students' product list (or the list of suggestions) and call out words one at a time. Instruct students to find the category or categories that each item belongs in on their bingo sheet and write the name of the product. There may be more than one natural resource for each product (for example, a pair of tennis shoes might fill three categories: plant, fossil fuel, and metal).

Step 5: The first student to fill the card wins. Use the T-R-A-S-H letters as free spaces. Be sure to check the student's bingo sheet to see if all answers are correct!

Step 6: After the bingo game, have each student circle the items that are made from renewable resources.



Assessment

1. What are natural resources?
2. What's the difference between renewable and nonrenewable natural resources?



Enrichment

1. Additional questions include asking students what happens if we keep using more and more natural resources? How can we stop using so many natural resources? How can we use more renewable resources and less nonrenewable resources?
2. Play show and tell. Have students bring in one of their favorite "things" and tell the class where it came from, including the resources used in producing it and how it came to be in their house. Have them describe what they will do with it when it is broken, old, used up, or no longer needed.
3. Conduct a scavenger hunt. Make a list of common items found inside or outside of the classroom that are derived from animals, plants, metals/minerals, fossil fuels, or sand. Have students find 15 of 30 items and identify which category they belong in. Give the students 15 minutes to look for the items, then call them together and discuss their answers.

Name: _____

Trash Bingo



Animals	Fossil Fuels	Metals	S	Sand
Plants/Trees	Metals	Metals	Sand	Fossil Fuels
Fossil Fuels	R	A	Plants/Trees	Sand
T	Animals	Sand	Plants/Trees	H
Plants/Trees	Fossil Fuels	Fossil Fuels	Metals	Metals



T	Animals	Metals	Fossil Fuels	Fossil Fuels
Sand	Plants/Trees	A	Metals	Sand
Animals	Metals	Metals	Fossil Fuels	Plants/Trees
Plants/Trees	Sand	Sand	S	Plants/Trees
Fossil Fuels	R	Plants/Trees	Fossil Fuels	H

Trash Bingo



Name: _____

Putting Products Under the Microscope



Objective

To have students evaluate a product to determine its resource use and overall impacts on the environment.



Activity Description

Students select a product manufactured in their community and discuss the raw materials and resources required to make the product.



Materials Needed

- Copies of *Product Inspector* worksheet for students.



Key Vocabulary Words

Products
Manufacturing process
Raw materials
Resources
Ecosystems



Duration

30 minutes



Skills Used

Communication
Observation/classification
Problem solving



science



language
arts



social
studies



Activity

Step 1: Explain that everyone uses a variety of products every day. Note that there is a manufacturing process involved in creating a new product and that any new product requires raw materials. (Refer to the Teacher Fact Sheets titled *Natural Resources* on page 5 and *Products* on page 25 for background information.)

Step 2: Have students select a product that is made in their community or state. Products might include bicycles, batteries, pens, milk, shoes, ships, plastic toys, glass bottles, or paper.

Step 3: Ask the students to draw a picture of the product. Then ask them to label all of the product's different parts and write both the

raw materials used to make each part as well as the original resources used to make the raw material on the *Product Inspector* worksheet. If a student draws a car, for example, he or she would label the dashboard and note that plastic is derived from petroleum.

Step 4: Discuss whether there are more raw materials required to make the product than expected. Ask where the raw materials come from—your town, state, country, or another nation. Discuss what happens to the environment when the raw materials are extracted from the Earth or harvested. Does this process produce pollutants or harm land or ecosystems? Discuss ecosystems in your geographical area that might be affected by the removal of raw materials. How might people living in the area be affected?



Journal Activity

Ask the students to name some products they could give up for a day, a month, or longer. Ask them to describe how giving up these items would affect other people and the environment.

Step 5: Ask students to describe what happens to the product after they use it. Can it be used up or will it wear out? Can the product or its parts be reused or recycled in some way? How? Will the product or its parts decompose if buried in a landfill? What effects does disposing of this product have on the environment? Who pays for disposing of the product? Who is responsible for disposing of it?



Assessment

1. Ask students how products are created.
2. Ask students how this process impacts the environment.
3. Have students explain what happens to products after we are finished with them.
4. Ask students if they think we really need all of the products we use. Why or why not?

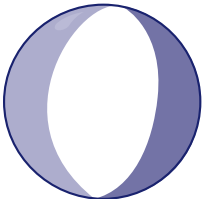
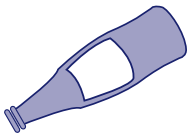


Enrichment

1. Contact or visit the manufacturer with your class to learn more about the process and materials used to make the product.
2. Ask students to name the different products they use during the course of a day (e.g., toothbrush, shoes). Make a list of these items on the blackboard. Then, ask students to categorize the product as essential to survival, necessary for living in today's society, or a luxury. Ask students if they are surprised how few products we really need and how many products are a luxury. Explain to students that all products create waste and that they should keep this in mind when they buy products.
3. Check books, articles, and magazines, or write to agencies or organizations to learn about the types of natural resources (e.g., wood, oil) that the United States obtains from other countries. Research whether these are renewable or nonrenewable resources. Describe what might happen if we begin to use up these resources. What can we do to conserve these resources?



Original Resources



Let's Go Eco-Shopping!



Objective

To teach students how to identify and evaluate the environmental attributes of products and assess their environmental impacts.



Activity Description

Research products that students buy and discuss their environmental attributes.



Materials Needed

- Five products with environmental claims on labels (e.g., a cereal box made with recycled content, an aluminum can with a recyclable symbol, a cleaning product marked "biodegradable").
- Product Review Worksheet (one for each student).
- EPA's Let's Go Green Shopping brochure located at www.epa.gov/epaoswer/education/pdfs/shopping.pdf. To order copies of this brochure, please visit www.epa.gov/epaoswer/osw/pub-l.htm or call EPA at (800) 490-9198 and reference document number EPA530-K-04-003.
- EPA and the Federal Trade Commission's Environmental Marketing Claims brochure at www.epa.gov/epp/documents/claims.htm.



Key Vocabulary Words

Postconsumer-recovered material content
Life cycle
Environmental attribute



Duration

2 hours over two class-room periods



Skills Used

Communication
Research
Observation/classification
Problem solving



Activity

Step 1: Bring in at least five products with environmental claims (e.g., aluminum cans, newspapers, paper towels) and examine them with the class. List the attributes on the chalkboard and discuss them (refer to the Teacher Fact Sheet titled *Buying Recycled* on page 107). For example, many paper products are manufactured with environmental attributes such as those listed in the "Environmental

Environmental Attributes for Paper

Preconsumer content
Postconsumer content
Recyclability of packaging
Recyclability of product
Reusability of item

Attributes for Paper" sidebar. Use the EPA/FTC *Environmental Marketing Claims* brochure to teach students what different labels mean



language
arts



social
studies



art



Journal Activity

Have students keep a journal of everything they buy in a week or on one trip to the mall (including food). Ask them to examine the purchases and think of ways to reduce waste on future shopping trips (e.g., take a reusable bag for carrying purchases, buy in bulk to reduce packaging waste).

(e.g., all natural, recycled-content percentages, biodegradable). Discuss product manufacturing (refer to the Teacher Fact Sheet titled *Products* on page 25 and its potential impact on the environment. Discuss how changing some of the practices involved in product manufacturing can increase or diminish a product's environmental impact over its life cycle (refer to *A Product's Life* on page 43).

Step 2: Divide into groups or have each student choose one product (from home or school) that could possess environmental attributes (e.g., binders with recycled-content plastic covers, paper clips with recovered plastic, energy-efficient computer). Have the students research his or her product (e.g., read product literature/labels, contact the company, Web research, visit a store that sells the product). Give students copies of the *Product Review Worksheet* and instruct them to answer the questions while researching.

Step 3: After students conduct and compile their research, have a class discussion where students report their results (discuss more than one product at a time if several students chose similar items. On the chalkboard, list the environmental attributes each person discovered. Discuss which products are the most environmentally sound and why. Point out that attributes can vary depending on local, personal, and other circumstances. For instance, if the students live in a desert community, products that conserve water might be most important to them.



Assessment

1. Ask students to think about their shopping habits. Before today's lesson, ask them if they consider environmental attributes when purchasing products. After the lesson, ask them if they will in the future. Discuss what kinds of attributes they will pay the most attention to and why.
2. Ask students to suggest environmental attributes to consider when purchasing some products other than those already researched (e.g., beverages, paint, food items).



Enrichment

1. Have students conduct a "mall scavenger hunt" to search for "green" products and/or the sustainable practices of stores or the mall (e.g., recycling bins). While on the scavenger hunt, students can take note of:
 - Stores that sell products with environmental attributes (e.g., bags with recycled content, biodegradable beauty products).
 - Recycling containers available for mall customers.
 - Store and/or mall managers who are knowledgeable about recycling, waste reduction, and green products.
2. Instruct students to select one of the products examined in this activity and create a detailed lifecycle flow chart of the steps involved in manufacturing, use, or disposal of the item (refer to the Teacher Fact Sheet titled *Products* on page 25 and *A Product's Life* on page 43).
3. Have students write and design a marketing brochure or public service announcement (refer to the *Memorable Media Messages* activity on page 215) that emphasizes a product's environmental attributes. Instruct students to develop the brochure targeting consumers. The brochures should explain why a consumer might purchase this item over a competing company's product. Students should pay special attention to the

guidelines outlined by EPA and the FTC in the *Environmental Marketing Claims* brochure.

4. Students can hold an open house to showcase the items they purchased. They can create a display of the “green” products and set it up either in the classroom or elsewhere in the school. Suggest placing an index card or small piece of posterboard next to each product explaining the environmental attributes it contains.
5. Students can hold an “eco” fashion show for their classmates or the whole school. They can create outfits by supplementing the items they found while shopping with used clothing from thrift shops. Suggest that they present the clothing and accessories in a live fashion show format or museum-type display (e.g., using mannequins, hangers).
6. Have students conduct research and write a report about a “green” company or a specific “green” product.
7. Have students write letters to companies. They can either write to ask a company why they do not sell/design green products, or they can thank a company for selling sustainable products.



Part of an eco-fashion show of reused clothing from thrift shops at a Pennsylvania middle school.

8. All toilet paper contains a percentage of recycled paper, but only some companies advertise this fact. Have students compare packaging for five different toilet paper brands to determine how many advertise that the paper is made from recycled content and how many do not. Write a letter to the companies that do not advertise the recycled content of their toilet paper, asking them why they choose not to promote this fact.

Product Review Worksheet

- 1.** List the environmental attributes of your product.

- 2.** Are there any brands of your product that advertise environmental attribute claims? If so, how many different brands are available?

- 3.** Which brand offers more environmental attributes?

- 4.** What are the costs of the different brands? If the price differences are substantial, why do you think that is?

- 5.** What attributes do you think are the most important and which products have those attributes?

- 6.** Why did you choose to purchase your product?

- 7.** Whether your product is an electronic or not, list some actions you can take to recycle electronics.



A Product's Life



Objective

To teach students the concept of product life cycles, including the various steps and related environmental issues involved.



Activity Description

Using the *Life Cycle of a CD or DVD* and/or *Life Cycle of a Cell Phone* or other life cycle posters as an example of a product life cycle, students research the steps involved in a product's life cycle and present their findings to the class.



Materials Needed

- The *Life Cycle of a CD or DVD* poster and/or *The Life Cycle of a Cell Phone* poster located at www.epa.gov/epaoswer/osw/students/finalposter.pdf and www.epa.gov/epaoswer/education/pdfs/life-cell.pdf. To order copies of these materials, please visit www.epa.gov/epaoswer/osw/pub-l.htm or call EPA at (800) 490-9198 and reference document numbers EPA530-H-03-002 and EPA530-H-04-002.
- Index cards.
- Library, computer/Internet access, EPA's *Let's Go Green Shopping Guide* (available at www.epa.gov/epaoswer/education/pdfs/shopping.pdf) or order online at www.epa.gov/epaoswer/osw/pub-l.htm), or other sources of research.
- For enrichment activity:
 - Scissors
 - Markers
 - Heavy-duty (cardstock) paper



Key Vocabulary Words

"Cradle to Grave"
Extraction
Life cycle
Manufacturing
Processing
Remanufactured products
Recovered materials
Virgin resources
(natural resources)



Duration

Day 1: 1.5 hours
Day 2: 1 hour



Skills Used

Research
Reading
Communications
Motor Skills



Activity

Day 1

Step 1: Introduce the concept of product life cycles. (Refer to the Teacher Fact Sheets, titled *Products* on page 25 and *Natural Resources* on page 5; the *Let's Go Eco-Shopping* activity

on page 39; the information on the *Life Cycle of a CD or DVD* and/or *Life Cycle of a Cell Phone* poster; and EPA's *Let's go Green Shopping Guide*.) Start by giving a general overview of life cycles, and relate this concept to something familiar to the students (e.g., our own lives, the life cycle of a tree). Continue by explaining that all products are made of something that ultimately comes from nature; and



language
arts



art



science

that all products end up somewhere after we are finished using them.

Step 2: Move on to more in-depth discussions of the various steps of a product's life cycle. Be sure to define each step: raw materials acquisition/extraction, materials processing, manufacturing, product packaging, distribution, use (lifespan), and end use (reuse, recycling, disposal). Discuss how each of these steps can have environmental consequences.

Step 3: Investigate the life cycle of an everyday item. Have the class select one or two products whose life cycles they would like to research. Choose a common product, such as one used often in class or at home. (For example: calculator, radio, remote control, light bulb, pencil sharpener, computer keyboard or mouse.)

Step 4: Divide the class into research teams for each item chosen. As a homework assignment or an in-class activity, have students work in groups of three or four individuals to research an individual step of the chosen product's life cycle. Students can use the library, Internet, and other resources, including those listed on the Teacher Fact Sheets in this binder.

Day 2

Step 5: Direct the students to use their findings to organize a short presentation to the class. Give each group a handful of index cards on which they can write down notes. Have each group give an oral presentation to the entire class on what they discovered through their research. Be sure to only discuss one product's life cycle at a time and have the groups present in the proper order of the steps of a life cycle (i.e., materials extraction, then processing, then manufacturing, etc.). Encourage the students to be creative, including using props or other visual means of presenting their information.



Assessment

1. Oral presentations can be judged and graded on the following criteria:
 - Comprehension of life cycle concept and comprehension of individual step in the life cycle.
 - Effectiveness of presentation
 - Creativity
 - Completeness
 - Research method and sources
 - Ability to work in a group
2. Ask the students if knowing more about a product's life cycle might affect their decision to buy the product. Discuss the choices we have as consumers. (Refer to the *Let's Go Eco-Shopping* activity on page 39 for more information.)



Enrichment


1. Compare the lifespan of various products and how this relates to product life cycles. For example, compare the environmental impacts of various types of cameras (disposable vs. traditional film vs. digital) as they relate to product life cycles. Include a discussion of the advantages/disadvantages of each product option.
2. Using the same groups created for the main activity, create a graphic display of the chosen product's life cycle.
 - a. Have each group of students create a graphic display of their step of the life cycle. Encourage the students to be creative but ask that each display indicates movement from one step of the life cycle to the next.
 - b. After each team gives their oral presentation, have the class work together to display the final product in sequential order along the walls of the room, in the hallway, or a similar appropriate space. (The end result may look similar to *The Life Cycle of a CD or DVD* poster when completed.)



CHAPTER

1.3

Waste



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Grade • Subject • Skills Index

Activity Name	Beware of Mr. Yuk	Trash Art	Weigh Your Waste	Trash Time Travelers	(Hazardous) Waste Not
Grade Range	K	✓	✓		
	1	✓	✓		
	2		✓		
	3	✓			
	4		✓	✓	
	5		✓	✓	✓
	6		✓	✓	✓
Subjects Covered	Math		✓		
	Science				✓
	Language Arts			✓	
	Social Studies	✓	✓	✓	✓
	Art	✓	✓		
	Health	✓			
Skills Used*	Communication			✓	
	Reading				✓
	Research			✓	
	Computation		✓		
	Observation/Classification	✓	✓		✓
	Problem Solving		✓		
	Motor Skills	✓	✓		✓

*See Glossary of Skills for more details.

Solid Waste

What Is Solid Waste?

Everyone produces solid waste (otherwise known as trash or garbage), whether it is old newspapers, potato chip bags, shampoo bottles, cut grass, food scraps from the dinner table, old appliances, or even the kitchen sink. Each person in the United States generates 4.4 pounds (EPA, 2003) of solid waste each day, which is often collected by a municipality and is known as **municipal solid waste**. This kind of waste primarily comes from people's homes, but it also comes from some factories, businesses, and schools.

As our population has grown, so has the number of products we use and the total amount of solid waste we generate. Consequently, the composition of garbage continues to change with more plastics, more office paper, and less glass filling up trash cans around the country. The chart below illustrates the different components of municipal solid waste.

How Do We Manage Solid Waste?

No single method can manage all our nation's garbage. The U.S. Environmental Protection

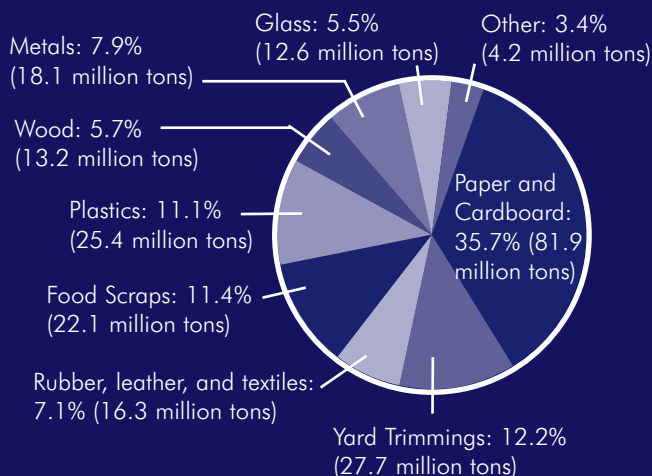
Key Points

- Americans generate about 4.5 pounds of garbage per person each day, which amounts to more than 220 million tons per year.
- EPA advocates a solid waste hierarchy, organizing waste management options in order of preference: source reduction, recycling and composting, and combustion and landfilling.
- Facing a variety of challenges—from rising waste generation rates and costs to closing disposal facilities—community leaders and businesses are devising ways to prevent waste and increase efficiency.

Agency (EPA) recommends the use of a “**waste management hierarchy**,” which ranks methods of waste management in order of preference. Although mentioned briefly here, each method is explained in separate fact sheets. Please refer to these other fact sheets for more information regarding the benefits, challenges, trends, and opportunities of each waste management system. EPA's waste management hierarchy includes:

- Source Reduction.** **Source reduction**, also known as **waste prevention**, is the preferred method of waste management because the best way to manage garbage is to prevent it in the first place. As the name implies, this method prevents waste at the source by decreasing consumption and reusing products. For example, using a durable cloth lunch bag or reusing the same brown paper bag instead of a new brown paper bag each day prevents waste. It also includes using nonhazardous substitutes as an alternative to toxic products that could end up in the waste stream. For example, using baking soda to clean kitchen and bathroom counters rather than a chemical detergent prevents the disposal of toxins.

Municipal Solid Waste Composition



Source: EPA, 2003; Note: This chart represents waste generation before recycling.

Household Hazardous Waste

Leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients are considered “**household hazardous waste**.” Examples of products that could become household hazardous waste include certain cleaning products, pesticides, motor oil, oil paints, adhesives, and batteries.

Unlike municipal solid waste, special care must be taken in disposing of household hazardous waste to minimize the impact on human health and the environment.

The best ways to reduce the amount of household hazardous waste being disposed of are to use up all of the products or share them with someone else until they are used up or properly recycle them.

If you are unsure of what to do with these products, contact your local environmental or solid waste agency.



- *Recycling, including Composting.* If waste cannot be prevented, the next best way to reduce the volume of it that must be disposed is to recycle or compost it. **Recycling** refers to a series of activities where discarded materials

are collected, sorted, processed, converted into raw materials, and used to make new products. **Composting** is the decomposition of organic materials such as yard trimmings and food scraps by microorganisms. The byproduct of this process is compost—a soil-like material rich in nitrogen and carbon that

can be used as a plant fertilizer supplement. Both of these processes use waste as a raw material to create new and valuable products.

- *Disposal: Combustion and Landfills.* Trash that cannot be reduced, recycled, or composted must be disposed of. **Combustion** is the burning of waste in specially designed facilities often called incinerators. It reduces the bulk of waste, and some facilities provide the added benefit of energy recovery (“**waste-to-energy**” facilities).

Landfills are also major components of waste management. A landfill is a large area of land or an excavated site that receives waste. Combustion facilities and

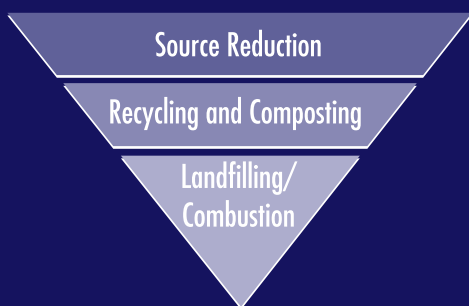
landfills are subject to environmental controls that require them to be properly maintained so there is no waste run-off that might contaminate drinking water supplies. The portion of waste requiring combustion and land disposal can be significantly reduced by reducing, reusing, or recycling—the “3 Rs” of solid waste management.

What Are the Benefits of Waste Management?

It might seem hard to believe now, but people once dumped trash out windows onto the streets, left it in local ravines or quarries, or burned it in fields and open dumps. In fact, throughout time, people have made garbage “go away” in different ways, regardless of environmental or aesthetic impacts. As one can imagine, these activities created serious sanitation problems for a community. Open dumps produced noxious odors, attracted rodents and pests that spread disease, and polluted drinking water supplies.

Federal, state, and local laws now control how solid waste is managed and disposed of. These regulations set standards for trash disposal. As a result of regulations, many communities have state-of-the-art landfills and combustion facilities that minimize ground- and surface-water contamination and air pollution. At the same time,

Solid Waste Hierarchy



they provide a safe and convenient way to remove trash from homes and neighborhoods.

Waste management can also create jobs and provide an economic boost to some cities and counties. Whether workers are collecting garbage, constructing disposal facilities, managing recycling programs, or developing new technologies, the waste management industry employs hundreds of thousands of people nationwide.

What Are the Challenges of Solid Waste Management?

Despite the improvements that have been made to solid waste landfills and combustion facilities over the years, the general public still does not want to live near a disposal facility. With varying public opinion and the Not in My Backyard (NIMBY) mentality, community leaders often find it difficult to find new sites for waste management facilities.

Balancing all of the management options in the solid waste hierarchy can be a major challenge. Many communities have invested resources in **source reduction** and recycling in an effort to reduce the amount of trash that must be land-filled or combusted. Yet reducing waste ultimately involves changing behaviors—purchasing environmentally friendly products

HHW Facts

- The average home may have up to 100 pounds of household hazardous waste stored throughout the house.
- Americans generate 1.6 million tons of household hazardous waste each year.

when possible, and participating in recycling and composting programs.

What Are Some Emerging Trends?

Communities continue to seek ways to reduce waste. One recent trend is to charge residents for garbage collection services based on the amount of trash they throw away, known as “**Pay-As-You-Throw**” (PAYT). By paying for garbage services in the same way as electricity, water, and other utilities, residents have a direct incentive to reduce the amount of trash they generate and to recycle more.



Additional Information Resources:

Visit the following Web sites for more information on municipal solid waste:

- U.S. Environmental Protection Agency (EPA): <www.epa.gov>
- U.S. EPA Office of Solid Waste site on municipal solid waste: <www.epa.gov/epaoswer/non-hw/muncpl/facts.htm>
- U.S. EPA Office of Solid Waste publications on household hazardous waste: <www.epa.gov/epaoswer/non-hw/muncpl/hhwpubs.htm>

To order the following additional documents on municipal solid waste, call EPA toll-free at (800) 490-9198 or look on the EPA Web site <www.epa.gov/epaoswer/osw/publicat.htm>.

- *Characterization of Municipal Solid Waste in the United States*
- *Sites for our Solid Waste: A Guidebook for Public Involvement* (EPA530-SW-90-019)
- *A Collection of Solid Waste Resources* on CD-ROM

Hazardous Waste

What Is Hazardous Waste?

Many of the appliances, products, and materials used in everyday life are manufactured using processes that create **hazardous waste**. From the paint on your walls, to the components of your car, to the shingles on your house, it is likely that when these products were made, some hazardous waste was generated. Hazardous wastes are substances that exhibit one or more of the following characteristics:

- **Toxicity**—harmful or fatal when ingested or absorbed.
- **Ignitability**—creates fire under certain conditions or spontaneously combusts.
- **Corrosivity**—contains acids or bases that can corrode metal.
- **Reactivity**—is unstable under “normal” conditions and can cause explosions, toxic fumes, or vapors when mixed with water.

Hazardous waste is created by a variety of different industries, such as petroleum refining and pesticide, chemical, ink, paint, and paper manufacturing. It also is created by the activities of certain smaller businesses found in many communities, such as dry cleaners, vehicle maintenance shops, vocational schools, and photoprocessing stores. In addition, hazardous waste is created when businesses or facilities dispose of certain unused products.

Hazardous waste is an inevitable product of a thriving industrial society. It is important to be aware that the choices consumers make when selecting products, services, and materials have hidden environmental effects. Consumers also should realize that the management of hazardous waste is regulated by law and that facilities that produce, transport, or dispose of it must follow very specific rules to minimize environmental and human health problems. The primary law that

Key Points

- Hazardous waste can be produced in the manufacturing process of many common products people use every day, as well as many common services.
- To protect human health and the environment, hazardous waste is regulated from the time it is produced to the time it is disposed of.

governs the proper management of hazardous waste is known as the **Resource Conservation and Recovery Act (RCRA)**.

How Do We Manage Hazardous Waste?

The RCRA regulations cover all aspects of hazardous waste—from the time it is generated at a factory or plant until the time it is discarded. This is known as **“cradle to grave.”** This regulatory system includes many detailed rules that require hazardous waste to be tracked as it



"Hazardous Waste" Versus "Household Hazardous Waste"

"Hazardous waste" is regulated by EPA. Businesses, institutions, or other facilities (sometimes including schools) that generate it must comply with certain rules regarding generation, management, transportation, and disposal.

When individuals dispose of household products from their home that contain hazardous ingredients, such as pesticides, cleaners, batteries, or used oil, they create what is known as **household hazardous waste**. Individuals usually produce much less hazardous waste than businesses and other facilities, and they are not regulated by EPA. Even so, many communities require or prefer that household hazardous waste is handled separately from the regular garbage to prevent any potential risks to the environment or human health.

When disposing of household hazardous waste from your home, remember the following:

- Sharing leftover household products is a great way for people to use all of a product and avoid disposal. If you cannot share or donate leftover products, check with your local environmental or solid waste agency to see if your community has a facility that collects household hazardous wastes year-round or offers opportunities for exchanging products with other residents.
- If your community doesn't have a collection program for household hazardous waste, contact your local environmental or solid waste agency to see if there are any designated days in your area for collecting these materials. On such days, qualified professionals collect household hazardous waste at a central location to ensure safe management and disposal.
- If your community has neither a permanent collection site nor a special collection day, you might be able to drop off certain products, such as batteries, paint, or automotive supplies, at local businesses for recycling or proper disposal. Call your local environmental or solid waste agency or Chamber of Commerce for information.
- Some communities allow disposal of household hazardous waste in trash as a last resort. Call your local environmental or solid waste agency for instructions on proper disposal. Be sure to read the product label for disposal directions to reduce the risk of products exploding, igniting, leaking, mixing with other chemicals, or posing other hazards on the way to a disposal facility. Even empty containers of household hazardous waste can pose hazards due to residue.

moves from place to place; one of the rules requires the use of a tracking paper known as a "manifest." This paper must travel with the waste wherever it goes (e.g., wherever it is stored, shipped, recycled, or disposed of).

Depending on how much waste a facility generates, it is regulated differently; bigger facilities that produce a large amount of hazardous waste each month have more rules than those that produce a small amount of waste.

After a company or factory generates hazardous waste, the waste must be packaged and labeled in special containers, and it must be transported

by a regulated hazardous transportation company in special packages with specific labels. These trucks often can be identified on the highway by multicolored placards and symbols that indicate the type of hazardous waste they carry. The Department of Transportation is responsible for regulating these trucks.

Hazardous waste is usually transported to a facility that treats, stores, and/or disposes of it. Most hazardous waste must be specially treated with certain processes to alter its hazardous composition before it can safely be recovered, reused, or disposed of. Sometimes waste is stored temporarily in a regulated unit. When the waste is

ultimately disposed of, it is transported either to a landfill or special combustion facility (see Teacher Fact Sheets titled *Landfills* on page 165 and *Combustion* on page 169). Combustion facilities must take special precautions to prevent air pollution, and they must ensure that only appropriate wastes are burned.

Sometimes hazardous waste is transported to a facility that recycles hazardous waste. Certain hazardous wastes can be recycled and used again. For example, many solvents can be recovered, some metals can be reclaimed, and certain fuels can be re-blended. Hazardous waste recycling is regulated under RCRA to ensure the protection of human health and the environment.

To keep track of all of the facilities that treat, store, or dispose of hazardous waste and ensure that they follow the rules, EPA and many states have a permitting system. Each company must obtain a permit, which tells companies what they are allowed and not allowed to do. Inspectors check these facilities regularly by reviewing company records, observing operating procedures, and sometimes collecting hazardous waste samples. For further tracking purposes, EPA also requires all companies that generate hazardous waste to register and obtain an EPA identification number.

What Are the Benefits of Hazardous Waste Management?

Before RCRA took effect in 1970, companies could—and did—dispose of hazardous waste in rivers, streams, and other inappropriate places. By enforcing strict rules about the way waste is handled, EPA and other agencies can better control the effects of hazardous waste on the environment and human health. These controls, while not always perfect, allow the industrial production on which we all depend to continue in as safe a manner as possible.

In addition, EPA has made waste minimization practices and pollution prevention activities key requirements for companies that produce hazardous waste. Any company that creates a

Hazardous Waste Facts

- In 2001, companies produced 40.8 million tons of hazardous waste.
- Nearly 20,000 large facilities generated hazardous waste in 2001.
- Many hazardous wastes can be generated in schools, such as solvents from cleaning, chemicals from chemistry labs, fluorescent light bulbs, computer monitors, and chemical residues from woodshops.

(Source: EPA National Biennial RCRA Hazardous Waste Report [2001 Data])



certain amount of hazardous waste each month must sign a statement indicating that it has a program in place to reduce both the amount and toxicity of its hazardous waste. These companies also must indicate that they have chosen a method of hazardous waste treatment, storage, or disposal that minimizes the present and future threat to human health and the environment.

It can be difficult for individuals to identify companies that have taken substantial measures to minimize hazardous waste and prevent pollution, and thus, it is not always possible to lend support for these activities by patronizing those companies. When information of this sort is available, however, consumer demand can make a difference.



What Are the Challenges of Hazardous Waste Management?

Just as people and communities generally do not want municipal solid waste facilities in their neighborhoods, they often do not want hazardous waste facilities near their homes and schools (the NIMBY mentality). When new hazardous waste generation or treatment facilities are sited near communities, the public can become involved in the process, but it can be a challenge for companies and communities to achieve mutually acceptable solutions.

The RCRA regulations allow the public to have an opportunity to participate in decisions about hazardous waste management. Through public meetings and other open forums, people can express their concerns about a new facility.

Additional Information Resources:

Visit the following Web sites for more information on hazardous waste:

- U.S. Environmental Protection Agency (EPA): <www.epa.gov>
- U.S. EPA Office of Solid Waste site on hazardous waste:
<www.epa.gov/epaoswer/osw/hazwaste.htm>

To order the following additional documents on hazardous waste, call EPA toll-free at (800) 490-9198 or look on the EPA Web site <www.epa.gov/epaoswer/osw/publicat.htm>.

- *The RCRA Public Participation Manual* (EPA530-R-96-007)
- *RCRA Orientation Manual: 1998 Edition* (EPA530-R-98-004)
- *RCRA: Reducing Risk From Waste* (EPA530-K-97-004)

Beware of Mr. Yuk!



Objective

To teach students to recognize the “Mr. Yuk” symbol; to help students understand that this symbol designates hazardous household products that should not be handled by children without adult supervision and without reading labels properly.



Activity Description

Students will identify Mr. Yuk stickers in the hidden picture and color them in bright green to signify hazard/poison.



Materials Needed

- One copy of the *Beware of Mr. Yuk* worksheet per student
- One red or green crayon for each student (Preferably from the fluorescent color box)



Key Vocabulary Words

Product
Poison
Danger



Duration

30 minutes



Skills Used

Observation/classification
Motor skills



Activity

Step 1: Put an enlarged picture of Mr. Yuk on the blackboard and ask students if they’ve seen it before. Elicit from students how they would describe Mr. Yuk.

Step 2: Tell the students they will be given a drawing of a house. In the picture are many products commonly found in homes, and they will have to find the ones with a Mr. Yuk face on them. Explain that if they were to find a real product in their real home with a Mr. Yuk face on it, they should not touch it; they should tell an adult about it. Ask them where Mr. Yuk products are sometimes located in a home (e.g., kitchen, bathroom, garage).

Step 3: Distribute crayons and worksheets to students and ask them to color only the Mr. Yuk stickers on the products they see. Students can work individually or in groups.

Step 4: After coloring the Mr. Yuk stickers, students can color the entire scene.

Mr. Yuk Stickers

Teachers who wish to promote the use of Mr. Yuk stickers at home could consider sending a note to parents indicating where stickers can be obtained. Most local poison control centers have Mr. Yuk stickers available.



art



health



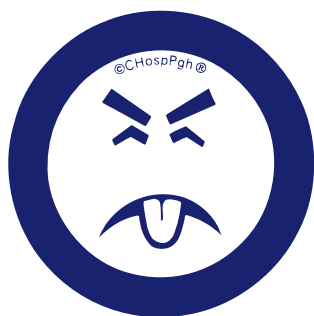
Assessment

1. Collect the *Beware of Mr. Yuk* worksheets and assess whether students correctly identified products labeled with Mr. Yuk.
2. Ask students what they would do if they found a Mr. Yuk sticker in their homes.
3. Ask students why certain products get labeled with Mr. Yuk stickers.



Enrichment

1. Conduct a role-playing game by putting a Mr. Yuk sticker on an empty product container and asking students to pretend they come upon it in their homes. Have one or more students pretend that they are parents and are telling the “kids” about the Mr. Yuk sticker and its importance.
2. Ask students to draw places in their homes where Mr. Yuk products might be found (kitchen, bathroom, garage, etc.)



Mr. Yuk is reprinted with permission, Children’s Hospital of Pittsburgh, Pittsburgh, PA.

Name:



Trash Art



Objective

To encourage students to think about what kinds of materials they throw away.



Activity Description

Students will create a trash mural from collected pieces of home garbage and images of disposable items from magazines.



Materials Needed

- One copy of Parents' Note for each student
- One tarp or drop cloth
- 10 to 12 magazines (with lots of everyday product advertisements)
- "Clean" garbage (brought in by students)
- Art supplies (enough for class):
 - Three to four sheets of colored construction paper per student
 - Glue
 - Tape
 - Scissors
 - Markers or crayons
 - Glitter



Key Vocabulary Words

Waste
Product



Duration

1 hour



Skills Used

Observation/classification
Motor skills



Activity

Step 1: Photocopy and send students home with the Parents' Note, which asks them to help the students collect two pieces of "clean" garbage for class the next day.

Step 2: Lead students in a discussion of what garbage is and where it comes from. Ask them if they know how to identify garbage.

Step 3: Lay a tarp on the floor and have the students sit in a circle around it. Ask them

to spread out their pieces of garbage on the tarp. Go around the room and ask each student to describe what kind of garbage they brought in. Explore how students knew the item was garbage and what its purpose was before it became garbage. Encourage the students to compare and contrast the shapes, colors, and sizes of the garbage on the tarp.

Step 4: Divide the class into pairs and distribute a magazine and scissors to each pair (teachers should use their judgement about the use of scissors for younger students). Tell the stu-



social
studies



art

dents to look for pictures of objects or products that are only used once and then thrown away. Ask the students to cut out as many of these objects as they can. Go around the room to discuss what pictures were chosen and why.

Step 5: Distribute the rest of the art supplies. The art exercise for this activity can be conducted in many different ways; below are a few age-specific suggestions:

For younger students:

- Instruct students to use their magazine pictures and trash objects to make a collage by gluing them onto the construction paper. Help all of the students tape their construction paper up on the classroom wall to form a colorful trash mural.
- Have students organize their trash in terms of color or size. Help students decide where each piece of garbage should go on the mural so that alike items are grouped together.

For older students:

- Have students make a trash rainbow by organizing the trash into rainbow colors. Students could draw the outline of the rainbow on the paper first, then paste their trash in the appropriate color band on the mural.
- Have students design a 3-D trash sculpture. Ask them to think about the color and shape of each trash item before gluing it onto the sculpture.
- Have students organize the trash by the purpose it had during its useful life. For example: was it a product or packaging for a product? A cleaning product, food product, or hair product? Ask students to write down category names on the mural and then paste their trash in the appropriate spot.



Assessment

1. Ask students to name three different items that they or their family members often throw away.
2. Have the students guess how many pieces of trash are on the class trash mural. Discuss with students that the mural is just a small amount of what gets thrown away every day in the world.
3. Ask students what purpose the trash served during its useful life. Ask them what it was before it became trash.



Enrichment

1. Conduct a followup activity on what happens to garbage after it's thrown in the trash can. This resource offers the following activities: *Luscious Layered Landfill* on page 173 (for younger students) or *A Landfill Is No Dump!* on page 177 (for older students).
2. Take a field trip to a waste disposal site (a landfill or incinerator) to find out where waste goes. See the Teacher Fact Sheets titled *Landfills* on page 165 and *Combustion* on page 169 for background information.
3. For grades 2-3, enrich the activities by doing the following:
 - After students have brought in pieces of trash, ask them to separate the items into the following categories: paper, metal, food, glass, plastic. Discuss whether these items need to be thrown away or whether they can be reused or recycled.
 - Have students determine how much of each category of trash items they have collected. Draw a trash can on the chalkboard and have students come up and use a different color piece of chalk to make hash marks (in the "trash can") for each type of trash item collected.

Parents' Note

Dear Parent,

Tomorrow we are undertaking an environmental education activity to learn more about how much garbage we create and what we do with it. I have asked each student to bring in two pieces of "clean" garbage for our trash mural. In the interest of safety and sanitation, I would appreciate your assistance in helping your child pick out two garbage items that are manageable in size and "clean" (no glass, jagged metal, food, or wet items). Good examples of "clean" garbage include: a cereal box, empty soda can, paper, plastic bag, wrapping, packaging, plastic juice bottle, etc.

Thanks for your help!



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Thanks for your help!



Weigh Your Waste!



Objective

To increase students' awareness of the amount of waste they generate and the implication of that waste.



Activity Description

Students will collect, weigh, record, and analyze the amount of trash they generate in the course of a week.



Materials Needed

- One trash bag per student
- One twist tie garbage bag fastener for each student
- One 3- by 5-inch note card per student
- One plastic tarp
- One set of gloves per student
- One scale
- One copy of *My Trash Journal* for each student
- Clear tape



Key Vocabulary Words

Waste
Per capita



Duration

1 to 2 hours, with periodic discussions over the course of a week



Skills Used

Computation
Observation/classification
Problem solving



Activity

Step 1: Photocopy and distribute copies of the *My Trash Journal* worksheet to each student. Refer to the Teacher Fact Sheet titled *Wastes* for background information.

Step 2: Distribute one garbage bag, one twist tie, and one note card to each student. Tell students to take the trash bag to classes for 1 week (5 days), using it to collect all of the "dry" garbage they throw away at school. Instruct students to include all of their used containers, paper waste, and packaging, but **not** to include food waste or any other type of "wet" trash that might decompose or be unsanitary. For safety reasons, instruct students not to collect glass items either.

Step 3: Have the students put their names on the note cards and tape them to the twist ties (or use a hole-punch). Then have students use the twist ties to close their garbage bags. Explain that at the end of each day, students will bring their garbage bags back to the classroom and store them overnight in a designated spot (show them the location). The name tags will allow them to pick out their trash bag the next morning.

Step 4: At the end of the week, ask the students to predict how much their individual piles weigh. Ask them to predict how much the total pile of garbage for the whole class would weigh. Write some of these predictions on the board.



math



social
studies



Journal Activity

Have students write a commercial “jingle” asking people to reduce the amount of waste they generate.

Step 5: Bring in a tarp and spread it on the floor. Have each student spread the contents of his or her personal trash bag on the tarp. Have the students put on gloves and sort their individual piles of garbage into as many categories as possible: plastics, aluminum, paper, steel, and mixed materials (those that fit into more than one category). Have them record the contents of their garbage piles using the *My Trash Journal* worksheet.

Step 6: Have students weigh their individual piles of garbage on a scale and record the amounts on the chalkboard.

Step 7: Ask a student to total the weights of each individual pile of garbage and put this number on the chalkboard. Determine the average weight of trash generated per student per day. Compare these weights to the students’ predictions.

Step 8: Write the national average of waste generation on the board: 4.3 pounds per person per day.

Ask the students to determine the following:

- How much waste did the class generate per day on average? Is this higher or lower than the national average?
- If each person in your community (population ____) throws away ____ pounds (use the students’ average calculated above) of garbage each day, how many total pounds of garbage are thrown away each day in your community?
- How many tons is this? (To help children grasp the concept of a ton [2,000 pounds] you might want to ask them how many tons some familiar objects weigh, for example, an average 4-door compact car weighs about a ton.)



Assessment

1. Ask the students why they think they generate so much trash. Is it more or less than they anticipated?
2. Ask the students if they were surprised at how much trash they generated. Where does all of this waste go every day? (See the Teacher Fact Sheet titled *Landfills* on page 165 for background information.) Why should we care how much we throw away?
3. Ask students to look at their waste generation charts and think of ways they could have reduced the amount of garbage generated this week. (Could any items have been recycled or reused? What about using less in the first place? For example, bringing a reusable cloth lunch bag instead of a paper lunch bag each day.) Refer to the Teacher Fact Sheets titled *Source Reduction* on page 79, *Recycling* on page 101, and *Composting* on page 141 for background information.



Enrichment

1. Have students identify the categories of materials they generally throw away or recycle. Make a list of common items on the board (recyclable and nonrecyclable). Ask students how much less waste they would have generated if they recycled instead of discarded all of the recyclable materials they used this week.
2. Have a student contact your state or municipal solid waste manager to find out about your community’s trash generation rate. How does it compare to other communities in your county or state? Discuss the results and reasons behind them with your students.
3. Have students record the amount of waste their families generate at home in 1 week (a note to parents explaining the assignment might help). Suggest students weigh each bag of trash generated on a bathroom scale.

Students should keep a log of these weights. At the end of the week, have students compare their data with classmates.

4. Either in class or as a homework assignment, ask the students to create graphs and charts of their data from class and home waste generation. The graphs might include:
 - A pie chart of the number of pounds for each material measured for each individual.
 - After pairing up with a partner and comparing notes, a bar graph of the number of pounds of each material for the two students.
 - A bar graph and/or pie chart showing the amount of total materials collected that were recyclable versus not recyclable in your community.

Discuss with students which materials were generated more than others and whether more recyclable or nonrecyclable materials were generated.

5. Take a field trip to a landfill or combustion facility so students can see what happens to their trash.
6. Partner with a local business to calculate how much waste the company generates in a given day by conducting an audit of the paper waste (or other dry waste) generated.
7. Get permission for your class to sort through the school dumpster on a given day (with appropriate safety equipment such as gloves and goggles) to weigh its amount and determine how much useful or recyclable material is thrown out.

My Trash Journal

Name:

What Did I Throw Away?	What Material Category Does it Belong In? (<i>Paper, Glass, Aluminum, Steel, Plastic</i>)	My Ideas for Using Less, Reusing, or Recycling this Item
Example: 1 soda bottle	Glass	I could recycle this in bins outside my school.
Example: 5 lunch bags	Paper	I could use a cloth lunch bag each day instead of using paper.
Total weight of my garbage for one week = [calculated in class]		
Weight of recyclables = [calculated in class]	Weight of nonrecyclables = [calculated in class]	
Total weight of my garbage per day = [calculated in class]		
Total weight of class garbage for one week = [calculated in class]		
Average amount of waste generated per student per day in our class = [calculated in class]		

Trash Time Travelers



Objective

To teach students how lifestyles change over time and how these changes alter the production and management of waste.



Activity Description

Students will interview adults, either at home or in the community, to find out what people considered trash years ago and how that trash was handled.



Materials Needed

- One copy of the *Rubbish Reporter* worksheet per student
- Brightly colored markers (one per student)
- One ball of string or twine
- One hole-punch
- One roll of masking tape



Key Vocabulary Words

Landfill
Recycle
Reuse
Combustion

(this list will vary for each student's interview)



Duration

2 hours over two class periods



Skills Used

Communication
Research



Activity

Step 1: Photocopy and distribute the *Rubbish Reporter* worksheets to each student. Conduct an introductory discussion touching on the following topics (refer to the Teacher Fact Sheet titled *Solid Waste* on page 47 for background information):

- Discuss what the common components of our trash are today—list them on the board.
- Ask students to think about how this list might differ from the trash list of a settler in colonial times, a farmer during the Great Depression, or a grandparent who lived through World War II.
- Discuss how trash is disposed of today and ask students how they think people of other time periods disposed of trash.

Step 2: Inform students that they are now “Rubbish Reporters.” Their assignment is to write a story about how different lifestyles in different historical periods affected the generation and handling of trash.

Step 3: Have students take the *Rubbish Reporter* worksheet home and use it to interview at least two elderly family or community members. Give students 2 or 3 days to complete this assignment.

Step 4: Have students bring in their completed *Rubbish Reporter* worksheets and pick one of their interviewees to focus on. As an in-class assignment, have the students use their completed worksheets to write a short paragraph or “article” about what their interviewee thought of “trash,” how they disposed of trash, and how those ideas and practices might differ from ours today. Instruct students to mark



language
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Journal Activity

Ask students to pretend that they are each of the following characters: a pilgrim living in the 1500s, a professional (business person) living in the city today, and a grizzly bear living today in Yellowstone National Park. Have students write about what kinds of trash they generate as each of these characters. Ask them which character they think is most wasteful and why.

(in the left-hand corner of the page) the year (or years) that their interviewee remembered or referred to during the interview.

Step 5: Go around the room and have each student stand up and read his or her article out loud to the class. Discuss the issues, such as time period, geographical location, trash disposal, and recycling, that are raised in each article.

Step 6: After discussing each article, have the students determine its one aspect of trash disposal or management that is most unique. (For example, someone may have saved all metal for recycling during WW II or burned his/her own trash on a farm each day, etc.) Have the student write this one aspect with a colored marker at the top of his/her article.

Step 7: Collect all of the articles and spread them out on the floor. Have the students help you organize them in a time line according to the years marked in the upper left-hand corner of the pages.

Step 8: Using the hole-punch, put holes in the tops of each article and connect them using the string. Hang your "Trash Time line" somewhere in the classroom or school.



Assessment

1. Collect all of the students' *Rubbish Reporter* worksheets and articles and evaluate them for completeness, comprehension, and content.
2. Ask students to offer an explanation of why trash and its management differs for each generation. Ask them to predict what trash will be like in the future and what people will do with trash 100 years from now.
3. Have students list four ways in which trash management in the past differs from trash management today.



Enrichment

1. If there are one or two very interesting or unique trash stories that students bring in, ask those interviewees to come in and speak to the class more extensively about their recollections. Have students prepare questions in advance to ask the guest speaker.
2. Using the different time periods or locations that surface during the students' interviews, pick one or two for an in-depth history and social studies lesson. Have students explore the setting of the time period, learn about the political and social events of that time, and investigate how these might have affected trash and its disposal.

The Rubbish Reporter

Name: _____

General Assignment: Ask your interviewee to pick a time in his/her past that is easy to recall in detail. Ask the interviewee to remember what he/she considered trash at that time (what was thrown out), how that trash was disposed of, where it was disposed of, and how all of these characteristics compare with today's ideas about trash and methods for handling trash.

Rubbish Reporter's name: _____

Interviewee's name: _____

What time period(s) does your interview cover? _____

What geographical location? _____



Interview Questions

1. What time period are you going to talk about? How old were you then? What was your occupation (if you were old enough)?

2. What were the most important political and social events during the time period you are remembering?

3. What did you consider trash when you were younger? What kinds of things did you throw out?

4. How was your trash handled? Was it picked up, sent to a landfill, burned? Who provided this service?

Student Handout

Interview Questions *(continued)*

- 5.** Did you reuse or repair items? What kinds of items did you reuse? Did you recycle? What did you recycle? What were recyclables made into or used for?

- 6.** Name some products that you use today that were not available to you then.

- 7.** What were many of your products (such as toys, food containers, or appliances) made of during this time period? Did you have a lot of plastic products? Glass? Metal? How were they packaged?

- 8.** What was your attitude toward trash then? Has it changed now?

Rubbish Reporter: Can you think of any more questions to ask?

- 9.** Do you think we are more wasteful as a society today?

(Hazardous) Waste Not



Objective

To show students what could happen to ground water if hazardous waste were not regulated.



Activity Description

Students will create an aquifer and demonstrate how hazardous waste could seep into ground water.



Materials Needed

- Clear plastic cup for each student
- *What's Going on Underground* diagram for each student
- Molding clay (enough for each student to have a ½-inch by ½-inch square)
- One-quart container filled with sand
- Container of small pebbles (enough for a ½ cup for each student)
- Bucket of water and ladle
- Red food coloring



Key Vocabulary Words

Aquifer
Hazardous waste
Byproduct
Regulation
Ground water
Saturated zone
Porous
Water table
Surface water



Duration

1 hour



Skills Used

Reading
Observation/classification
Motor skills



Activity

Step 1: Discuss with the class how ground water is a major source of drinking water for as much as half of the U.S. population. Provide each student with the *What's Going on Underground* diagram and discuss how ground water forms, exists, and can be extracted. Review the vocabulary words and definitions provided on the diagram. Explain that it would be very easy to contaminate ground water if hazardous waste were simply dumped on the ground and absorbed by the soil. Define and discuss hazardous waste. (Refer to the Teacher Fact Sheet titled *Hazardous Waste* on page 51 for background information.)

Step 2: Place the containers of pebbles, sand, and bucket of water with the ladle on a table in the classroom where each student can access them.

Step 3: Pass out a plastic cup to each student. Ask the students to fill their cups half full

RCRA and Hazardous Waste

In 1976, Congress passed the Resource Conservation and Recovery Act (RCRA) to protect human health and the environment from the potential hazards of waste disposal. RCRA establishes a regulatory system for managing hazardous waste from generation until ultimate disposal ("cradle to grave").



Social
Studies



Science



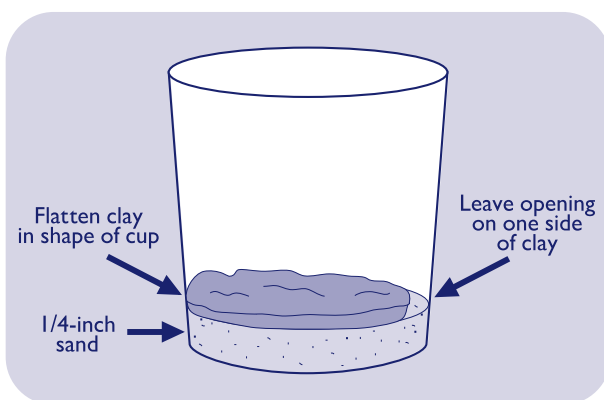
Journal Activity

Ask students to prepare questions and answers representing an interview with an animal, tree, flower, or other member of nature. Students should think about how elements in nature would “feel” about hazardous waste contamination in the environment. Have them pretend they are reporters trying to discover how hazardous waste can affect the natural environment.

of small pebbles. In addition, give each student a ½-inch by ½-inch piece of the molding clay. Ask the students to dump the pebbles on their desk and keep them there temporarily.

Step 4: Ask each student to go to the sand container and scoop enough so that there is about 1/4-inch on the bottom of their cups. After they add the sand, ask them to ladle just enough water into the cup so that it is absorbed by the sand. Discuss how the water is still in the cup, but that it is being stored in the “ground.”

Step 5: Have each student flatten their clay in the shape of the cup bottom and then place it over the sand. Fasten the clay to one side of the cup, but leave an opening on the other side.



Step 6: Ask each student to place their pile of pebbles into the cup, on top of the clay. They can place the pebbles so that they lay flat or form hills and valleys.

Step 7: Ask the students to add a ladle full of water to their “aquifers.” Students that formed hills and valleys with their pebbles will see that they have surface water in addition to ground water, depending on how much water they added to their cups. Discuss how both surface and ground water can be sources of drinking water and that some parts of the ground are more porous than others (e.g., water slips more easily through the pebbles than the clay).

Ground Water Contamination

Ground water contamination can occur when liquids (usually rainwater) move through waste disposal sites, carrying pollutants with them, and into the ground water. RCRA regulations require ground water monitoring, which detects early signs of contaminants leaching from hazardous waste facilities.

Step 8: Tell the students to imagine that there is a factory that produces “widgets” near their aquifer. In the course of producing widgets, the factory produces a hazardous waste byproduct. Ask students to imagine that hazardous waste regulations do not exist and that the factory is allowed to dump its hazardous waste on the ground outside, which is also an aquifer.

Step 9: Pass the food coloring around the room so that each student can add a few drops to their aquifers. Explain that the food coloring represents hazardous waste that is being dumped illegally. Ask the students to watch the path of the food coloring.

Step 10: Discuss how easy it is to pollute and contaminate the ground water. Explain that this is why the government has created very detailed laws about how companies must deal with their hazardous waste.



Assessment

1. Ask students to explain how activities above the ground can affect the water underground.
2. Have students tell you why hazardous waste is regulated.



Enrichment

1. Draw a map of your community or region including all the waterways. Add a local source of potential hazardous waste pollution to the map and trace the path its waste would take if it were not regulated. (See the sidebar for examples of local hazardous waste generators.) Discuss how streams and creeks feed into larger bodies of water and how pollution at a small, local stream can result in pollution in rivers, lakes, bays, and/or oceans. This activity can be used to teach or review the concept of “bird’s-eye” view, the different types of maps, and the use of legends and symbols.

2. Using papier maché or modeling clay and water-based paints, develop a relief map of the community or region including all waterways. To physically show how hazardous waste can travel through all waterways, put a few drops of food coloring on one end of the map. Tilt the structure, if necessary, and watch the food coloring travel.
3. Elicit what would happen to our waterways if they became contaminated by hazardous waste. How would people and ecosystems be affected?

Examples of Local Hazardous Waste Generators

Dry cleaners
Print shops
Vehicle maintenance shops
Photoprocessing stores

What's Going On Underground?

